REMARKS

Reconsideration of this Application is respectfully requested. Upon entry of the foregoing amendments, claims 1-21 are pending in the application, with claim 1 being the independent claim. Because the foregoing changes introduce no new matter, their entry is respectfully requested.

Based on the above Amendment and the following Remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Objections to the Drawings

Applicants respectfully submit that the Examiner's objection of FIG. 1 is overcome by the accompanying amendment thereto.

Objections to the Specification

The Examiner made objections to the specification based on the status of non-provisional applications. Applicants respectfully submit that the Examiner's objection to the specification is overcome by the accompanying amendment thereto.

Rejections under 35 U.S.C. § 102

Claims 1-21

The Examiner has rejected claims 1-21 under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 5,302,470 to Okada *et al.* Okada *et al.* does not disclose each essential feature of the present invention as called for by independent claim 1.

The present invention as defined by claim 1 is a process for producing electricity in a fuel cell. The process requires a number of steps, the first being reacting a higher carbon (C_{2+}) hydrocarbon fuel with steam in a steam pre-reformer. The temperature at which this reaction takes place is stated to be no greater than 500°C. The product of the reaction is a fuel stream

including hydrogen and a specified minimum amount of methane (no less than 20% by volume methane measured on a wet basis). The process also then requires supplying this fuel stream and an oxidant to a high temperature fuel cell. It is a further requirement of claim 1 that methane present in this fuel stream is reformed in the fuel cell. What this means is that the anode of the fuel cell includes a suitable catalyst in order to catalyse reforming of methane in order to produce hydrogen. In this respect the process of the present invention differs from conventional processes in which the fuel cell operates on a fuel stream of hydrogen. In such conventional process it is desirable to have a high hydrogen content and a low methane content since there is no reforming of methane within the fuel cell in order to generate hydrogen.

Okada *et al.* is openly acknowledged in the paragraph bridging pages 2 and 3 of the present specification. The process described by Okada *et al.* involves a steam reforming reaction in order to generate a hydrogen-rich fuel stream which is then delivered as fuel to the anode of a fuel cell. In this respect the disclosure of Okada *et al.* is exactly the same as the conventional fuel cell technology just mentioned. There is however no disclosure in Okada *et al.* of steam reforming of a higher hydrocarbon fuel in order to generate a fuel stream having a minimum methane content of 20% by volume, followed by internal reforming of methane in this fuel stream in the fuel cell. The kind of fuel cell employed in Okada *et al.* operates on hydrogen as a direct form of fuel and is not adapted to generate hydrogen by reforming of methane in the fuel cell. In the present invention, and as clearly stated in claim 1 of the present application, steam pre-reforming results in the fuel stream having a methane content no less than 20% by volume and methane reforming takes place in the fuel cell. These features are neither disclosed nor suggested in Okada *et al.* Indeed, formation of a fuel stream with the intention of achieving a minimum methane content is contrary to the kind of fuel cells Okada *et al.* uses.

When one considers Okada *et al.* in detail, it is apparent that the invention disclosed relates to the use of a copper/zinc desulfurizing agent in order to achieve very low sulfur content in a fuel cell supply stream. If the sulfur content in the fuel cell supply stream is high, the catalyst present in the reformer may be poisoned. Use of the specific type of catalyst taught by

Okada *et al.* is said to attenuate poisoning of the reforming catalyst (see column 3 lines 59-62, column 4 lines 22-30 and column 5 lines 5-9 of Okada *et al.*).

The Examiner has referred to Table 1 of Okada *et al.* as showing the kind of methane content called for in claim 1 of the present application. However, Table 1 actually reports the methane content of a town gas before any steam reforming has taken place. Table 1 does not report the methane content of town gas after steam reforming. It is therefore not appropriate to compare the methane content given in Table 1 of Okada *et al.* with the methane content required by claim 1 of the present application. Table 1 of Okada *et al.* specifies the methane content of a hydrocarbon fuel (town gas) rather than the methane content of a fuel stream produced by steam pre-reforming of the hydrocarbon fuel.

A number of examples in Okada *et al.* do however show the methane content after steam reforming of hydrocarbon fuel. Thus, Examples 8, 9, 10, 11 and 12 describe processing a hydrocarbon fuel using a steam reforming and desulfurization reactor identical to that used in Example 1. The composition of the hydrocarbon fuel after steam reforming is given in Tables 3, 5, 6, 7 and 8. It will be noted that in each of these tables the methane content of the fuel stream leaving the reformer is very low (3.9, 3.4, 3.5, 3.1 and 2.3%, respectfully), whereas the hydrogen content is very high (58.5, 53.5, 54.8, 57.6 and 56.2%, respectfully). The output of the steam reformer in these examples is then delivered to a CO converter but the methane content is unaffected by this. This means that the fuel stream provided to the fuel cell in each of the examples mentioned in Okada *et al.* will be rich in hydrogen and have a relatively low methane content. The methane content is certainly well below the minimum of 20% by volume required by claim 1 of the present application. Again, this is hardly surprising since the fuel cells taught in Okada *et al.* are not adapted to internal reforming of methane.

The effect of steam reforming according to Okada *et al.* may be seen by comparing the figures given Tables 1 and 3 included in Okada *et al.* Table 1 reports the initial content of town gas prior to steam reforming. Table 3 reports the content of the town gas after steam reforming (note that column 16 lines 3-5 preceding Table 3 describes use of town gas composed of the

ingredients listed in Table 1). It is immediately clear when one considers Tables 1 and 3 that the effect of steam reforming is to significantly reduce the content of methane and to significantly boost the hydrogen content. Again, this is entirely consistent with the fact that the kind of fuel cell systems described by Okada *et al.* are conventional in the sense that they rely on hydrogen as primary fuel input to the fuel cell. In contrast, the process of the present invention relates to the use of fuel cells which are capable of effecting internal methane reforming, and this is reflected by the fact that in claim 1 of the present application the fuel stream delivered to the fuel cell is produced so as to include no less than 20% by volume methane.

In summary, it is submitted that there is no disclosure in Okada *et al.* of steam reforming a higher carbon hydrocarbon fuel in order to produce a fuel stream having a methane content no less than about 20% by volume measured on wet basis. Furthermore, there is no disclosure Okada *et al.* of supplying such a fuel stream (i.e. having such a methane content) to a high temperature fuel cell where methane is reformed in the fuel cell.

For at least these reasons, Applicants respectfully submit that the Okada *et al.* do not anticipate presently amended claim 1. Applicant submits that claims 2-21, which depend from claim 1, are allowable over the cited art for at least the same reason noted above.

CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided below.

The Commissioner is hereby authorized to charge any underpayment of fees associated with this communication, including any necessary fees for extension of time or additional claims,

PATENT

Attorney Docket No. A-71327/DJB/VEJ
Attorney Matter No. 461124-00021
Application No. 10/049,705

and/or credit any overpayment to Deposit Account No. 50-2319 (Order No. 461124-00021; Docket No. A-71327/DJB/VEJ).

Prompt and favorable consideration of this Amendment and Response is respectfully requested.

Respectfully submitted,

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Date: April 12, 2004 By: _____

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